LA-UR-21-32439

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Title:	AOT All-Hands Meeting
Author(s):	Milton, Stephen Val
Intended for:	All Hands Meeting Presentation slides
Issued:	2021-12-21

Los Alamos NATIONAL LABORATORY

AOT All-Hands Meeting

2021:3

2021 December 16

AGENDA

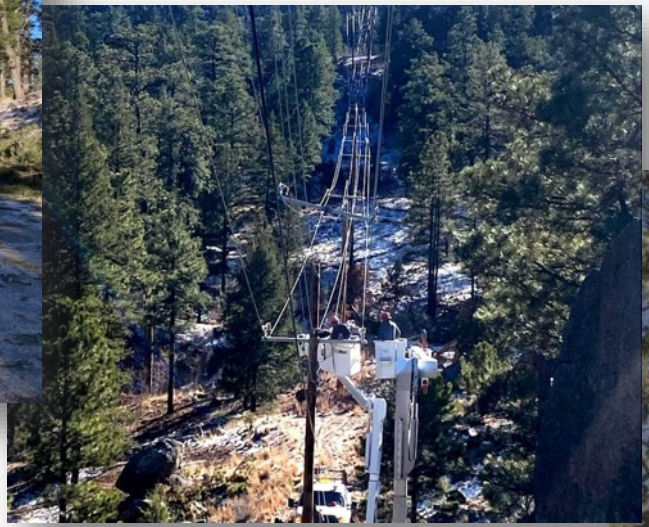
- *Safety*
- *Communications*
- *Our Team – Year in Review*
- *Group Highlights*
- *AOT Goals for Next Year FY22*
- *Open to Questions*

Safety

Scary Crazy Weather: 15 December 2021

NM 4 Bandelier Area

(Courtesy of Sandoval County Fire Rescue)



Behind Los Alamos Golf Course

(Courtesy/LAC)

Cathedral Basilica of St. Francis of Assisi

(Jim Weber/The New Mexican)

Scary Crazy Weather: 15 December 2021

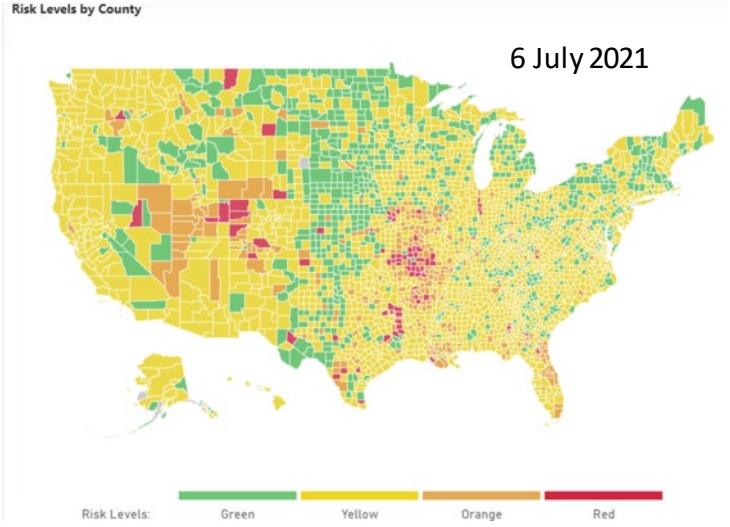
Santa Fe Airport
(Kenneth McGlothin | KRQE Photojournalist)

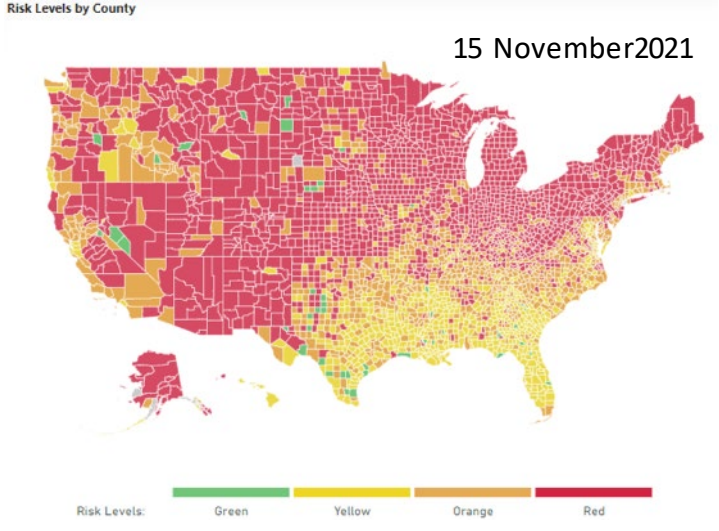
Outside of Taos
(Courtesy Nathan Burton/Taos News)

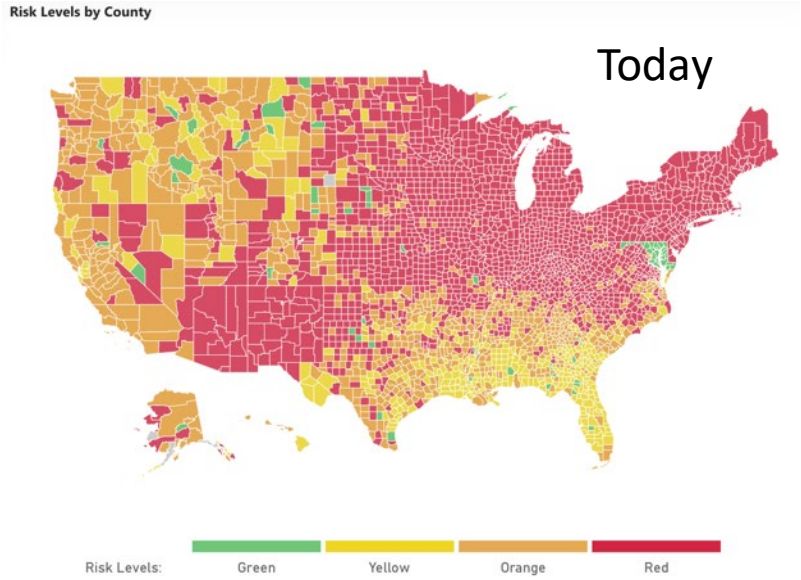
More downed trees
(Courtesy of Sandoval County Fire

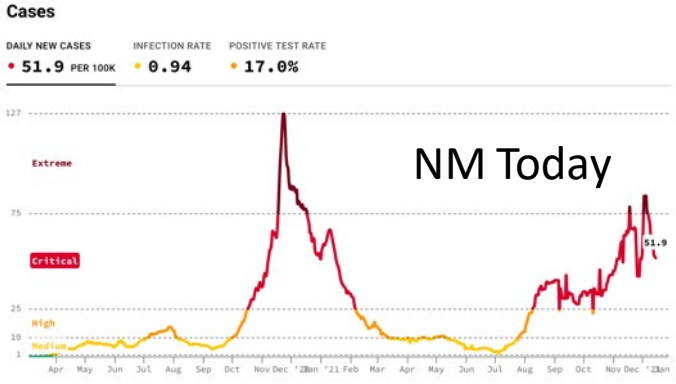
Be careful!! Stay safe!!

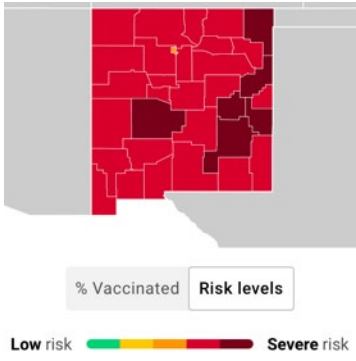
COVID is Still a Major Problem











Communications

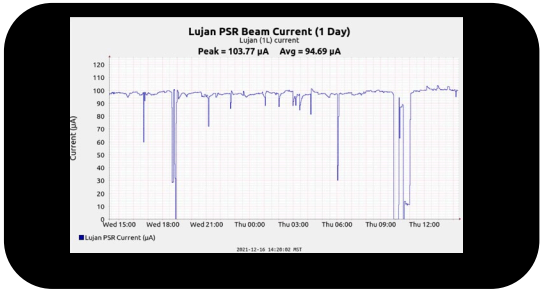
Communications

- All Hands Meeting
  - 3 per year
    - 1 focused on a review of the previous run cycle (February)
    - 1 focused on a review of the maintenance period (July)
    - 1 focused on all other items (November or December)
- Coffee Chat
  - Biweekly
    - So far only via Webex
    - We really want to make this an in person “chat” with real coffee, tea, and cookies
    - Open discussion forum for general topics. All questions are welcome.
- Weekly Newsletter
  - Mostly Weekly
    - General purpose update
    - Always looking for input

AOT Branding Effort

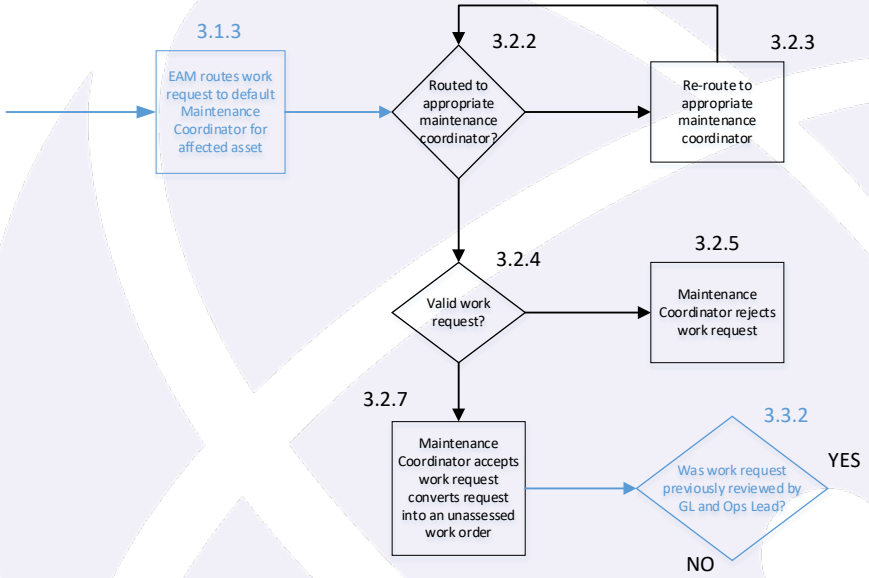
~~All the news fit to print~~

“Scoreboard” Monitors

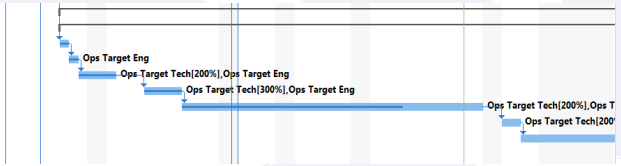


AOT-DO Project Management

- Project Management
  - Striving to improve how we plan, schedule, track, and coordinate project work and machine maintenance
  - Examples
    - Integrated division-wide resource-loaded schedule for the FY22 Extended Outage
    - Aid in coordinating the 1L Target Project and IPF Recovery Project
- Asset Management Project
  - Initial steps on path to improve how we manage maintenance, maintenance data, and parts/spares in a sustainable way
  - Ultimately seeking less machine down time and more predictable operations



102		2.3	Cask (Target Team)	37 days	Wed 11/3/21	Wed 1/5/22	Wed 11/3/21	NA	63%		
103		2.3.1	Unload, disassemble, and disposition old beamline equi	35 days	Wed 11/3/21	Mon 1/3/22	Wed 11/3/21	NA	67%		
104		2.3.1.1	Prepare work area for remote handling	1 day	Wed 11/3/21	Wed 11/3/21	Wed 11/3/21	Wed 11/3/21	100%	99FS+2 days,100	
105		2.3.1.2	Prepare draft work documents	1 day	Thu 11/4/21	Thu 11/4/21	Thu 11/4/21	Thu 11/4/21	100%	104	Ops Target Eng
106		2.3.1.3	Setup remote handling equipment	2 days	Fri 11/5/21	Mon 11/8/21	Fri 11/5/21	Mon 11/8/21	100%	105	Ops Target Tech[200%],Ops Target Eng
107		2.3.1.4	Construct mockup containments	2 days	Fri 11/12/21	Mon 11/15/21	Fri 11/12/21	Mon 11/15/21	100%	106FS+2 days	Ops Target Tech[300%],Ops Target Eng
108		2.3.1.5	Test remote handling equipment and methodologies	22 days	Tue 11/16/21	Fri 12/17/21	Tue 11/16/21	NA	70%	107	Ops Target Tech[200%],Ops Target Eng
109		2.3.1.6	Construct and finalize setup	2 days	Mon 12/20/21	Tue 12/21/21	NA	NA	0%	108	Ops Target Tech[200%],Ops Target Eng
110		2.3.1.7	Conduct operation	2 days	Wed 12/22/21	Mon 1/3/22	NA	NA	0%	109	Ops Target Tech[300%],Ops Target Eng,RCT[200%]
111		2.3.2	Prepare cask for loading	2 days	Tue 1/4/22	Wed 1/5/22	NA	NA	0%	110	Ops Target Tech[200%],Ops Target Eng,RCT



Our Team – Year in Review

New Hires/Job Changes within AOT

- ***David Zimmerman***, AOT-IC
- ***Bhavini Singh,*** AOT-MDE
- ***Rudolph D. Bednar***, AOT-MDE
- ***Patrick Lance,*** AOT-MDE
- ***Steve Elliser,*** AOT-IC
- ***Daniel Sandoval,*** AOT-RFE
- ***David Newman,*** AOT-OPS
- ***William Thomas Roybal,*** AOT-RFE, Deputy Group Leader
- ***Alex Scheinker,*** Transfer to AOT-AE
- ***Christine "Tina" Hartzell,*** AOT-RFE (Jan)
- ***Fernando Carrasco,*** AOT-RFE (Jan)
- ***Keith Woloshun,*** AOT-MD Deputy Group Leader
- ***Heath Watkins,*** AOT-IC, Deputy Group Leader
- ***Steven Dryja***, AOT-OPS

2021 Students who joined AOT and/or are Currently here

- Shuprio Ghosh, AOT-MDE
- Jaylyn Gould, AOT-MDE
- Taylor Quintana, AOT-MDE
- Amare Rodriguez-Vigil, AOT-MDE
- Athena Grace Martinez, AOT-RFE
- Nicholas Mozyrsky, AOT-AE
- Emily Jevarjian, AOT-AE
- Grace Toohey, AOT-AE
- Iyan Ayres, AOT-AE

2021 Farewells to: AOT Staff Retirements or Have Left AOT/LANL

- John Lewellen, AOT-DO
- Mike Borden, AOT-MDE
- Nathan Kollarik, AOT-MDE
- Harbhajan Khalsa, AOT-MDE
- Chris Bast, AOT-OPS
- Leah Sanchez, AOT-OPS
- Hargis James, AOT-OPS
- John Faucett, AOT-IC
- Colin Harvey, AOT-IC
- Dan Rees, AOT-RFE
- Mark Kirshner, AOT-RFE
- John Harrison, AOT-RFE
- Danny Vigil, AOT-RFE
- Gary Sanchez, AOT-RFE
- John Wilson, AOT-RFE
- Ray Bratton, AOT-RFE
- Dale Dalmas, AOT-AE
- Ryan Fleming, AOT-AE
- Kimberley Nichols, AOT-AE
- Derek Neben, AOT-AE

2021 AOT Service Anniversaries

- Robert White, AOT-OPS, **35**
- Jeffrey Hill, AOT-IC, **35**
- Michael Borden, AOT-MDE, **35**
- David Bell, AOT-OPS, **30**
- Joe Bradley, AOT-RFE, **25**
- Mark Gulley, AOT-DO, **25**
- Sergey Kurennoy, AOT-AE, **25**
- Raymond Roybal, AOT-MDE, **25**
- Mark Prokop, AOT-RFE, **20**
- Everette Espinoza, AOT-OPS, **20**
- Gary Rouleau, AOT-AE, **20**
- Pilar Marroquin, AOT-IC, **20**
- Esteban Figueroa, AOT-OPS, **20**
- Gary Sanchez, AOT-RFE, **20**
- James O'Hara, AOT-MDE, **20**
- Jake Sandoval, AOT-RFE, **20**
- Ernest Geros, AOT-RFE, **20**
- Nathan Moody, AOT-AE, **15**
- John Bernal, AOT-MDE, **15**
- Leanne Duffy, AOT-AE, **15**
- Gilbert Sandoval, AOT-RFE, **15**
- Scott Baily, AOT-IC, **15**
- Manuelita Rodriguez, AOT-RFE, **15**
- Heath Watkins, AOT-IC, **10**
- Benjamin Drury, AOT-OPS, **5**
- Antonio Garcia, AOT-OPS, **5**
- Jon Bergemann, AOT-RFE, **5**
- En-Chuan Huang, AOT-AE, **5**
- Brandon Turner, AOT-MDE, **5**
- Janardan Upadhyay, AOT-AE, **5**
- Heather Leffler, AOT-IC, **5**
- Stephen Rivas, AOT-OPS, **5**
- Julie Vargas, AOT-MDE, **5**
- Christopher Carlisle, AOT-OPS, **5**

2021 AOT Spot Awards

- John Harrison
- Jose Urioste (2)
- Geraldine Archuleta
- Matthew Buck
- Simon Johnson (2)
- Vincent Kutac
- Anthony Valdez
- Martin Pieck (2)
- Scott Baily (2)
- Derwin Martinez
- Lucas Montoya
- Daniel Byers
- John Chamberlin
- Manuel Soliz
- Walter Barkley
- Joe Bradley
- Anju Poudel (2)
- Mark Prokop
- Gary Rouleau (2)
- Gary Sanchez
- Joe Snyder
- Laura Walker
- Heath Watkins
- Maria Sanchez-Barrueta
- Greg Dale (2)
- Robert Migliori
- Gabriel Cordero-Rivera
- Aaron Archuleta
- Ernest Geros
- Shayne Wulf
- Jason Burkhart
- Esteban Garcia
- Jordon Marquis
- Brandon Roller
- Connel Lane
- Manuel Soliz
- Julie Vargas
- Thomas Hall
- Prabir Roy
- Nancy Torres
- Janardan Upadhyay
- Sean Herrera
- Lisa Padilla
- Peter Hannis Naffziger
- Sean Tomas Hollander
- Robert Aragonez
- Athena Grace Martinez
- Manuelita Rodriguez
- Lawrence Castellano
- John Lyles
- Gabriel Ray Roybal
- Daniel Steven Sandoval
- Jon E. Bergemann
- Rodney Craig Mccrady
- Sergey S. Kurennoy
- Melissa R. Martinez

2021 LAAP Awards

- En-Chuan Huang, AOT-AE
- Walter Barkley, AOT-MDE
- Gary Rouleau, AOT-AE
- Joe Bradley, AOT-RFE
- Gabriel Cordero-Rivera, AOT-RFE
- John Wilson, AOT-RFE
- Gary Sanchez, AOT-RFE
- Lee Merrill, AOT-RFE
- Henry Gaus, AOT-RFE
- Jacob Sandoval, AOT-RFE
- Jason Martinez, AOT-RFE
- Joshua Brito, AOT, RFE

Additional Awards

DPA Small Team Award

- LANSCE 805-MHz Risk-Mitigation Modulator Team

DPA Large Team Award

- Isotope Production and Early Startup Under COVID Team

American Physical Society (APS) Fellow

- Nathan Moody

Group Highlights

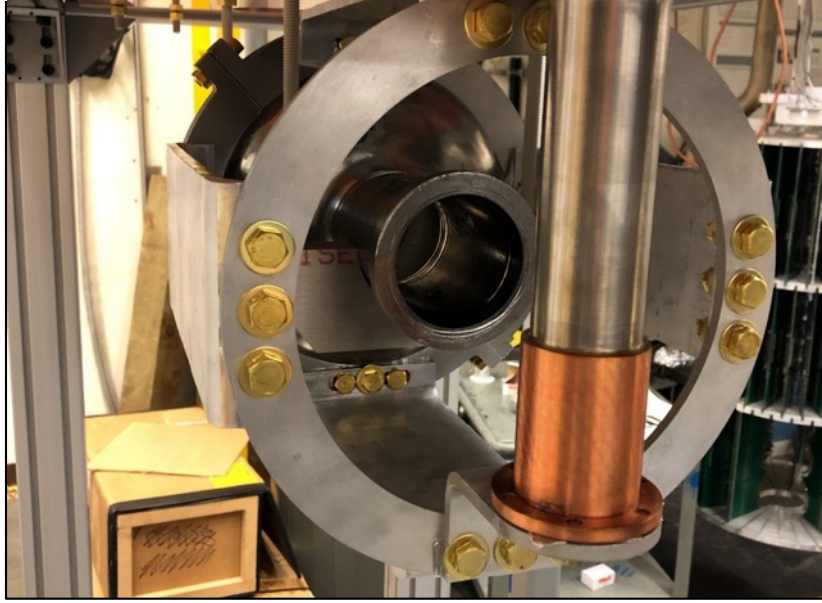
Mechanical Design and Engineering

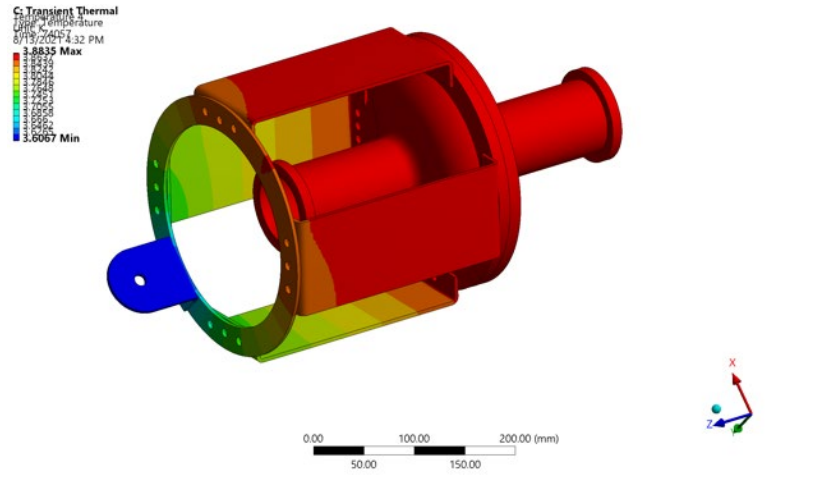
IPF Push-Pull Target Positioning Mechanism Install

- AOT-MDE & AOT-IC in coordination with C-IIAC installed a new target positioning mechanism for the IPF Facility.
- Serapid rigid “Push-Pull” chain replaces existing circulating bicycle chain system in IPF Hot Cell.
- High risk – 40-ft travel down to high rad target station. Once the old chain was cut, there was no going back.
- Extensive testing done to ensure successful installation and system performance.
- Work completed safely on schedule and on budget.

Cryogenically Cooling NC Accelerator Cavities - LDRD

- Successful LDRD project that featured novel use of conduction cooling with a cryogen-free cryocooler.
- Project goal was to acquire critical data needed for operation of NCRF accelerating structures.
- MDE and AE collaboration on design, analysis, fabrication, and experiment.
- Highly synergistic with LANL's goal to develop cryogenically-cooled C-Band NCRF accelerator structures.





TMRS 1L MK IV Lower Tier Sub-Assembly

- Completed at Welder in Bay Area - Sept 2021
- Consists of 80% of total Components
- Lower & Middle Targets
- Lower & Upper Steel Reflectors
- All Be Reflectors
- LH Moderator & 3 Water Moderators
- 3 Port Liners & Saddle Shield
- Quantity of 65 Type K & T Thermocouples
- All tube welding with template fixturing.

TMRS 1L MK IV Top Assembly in Bldg 365

- AOT-MDE & AOT-OPS
- Assembly In Process – Oct-Dec 2021
- Consists of Lower Tier Sub-Assembly & Shield Plug
- Shield Plug mated with all tubing in place
- Positioned on the assembly platform in high bay of 365 for weld ring welding & Thermocouple feedthrough work
- Final Window & Instrument Sub-Assembly work is on-going
- Projected completion – late December to Early January 2022

Group Highlights

Operations

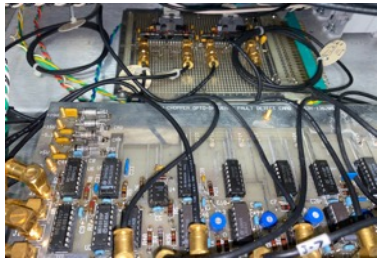
Protective Systems Team

Chopper Pattern Fast Protect Fault Chassis

Old Face Plate

New Face Plate

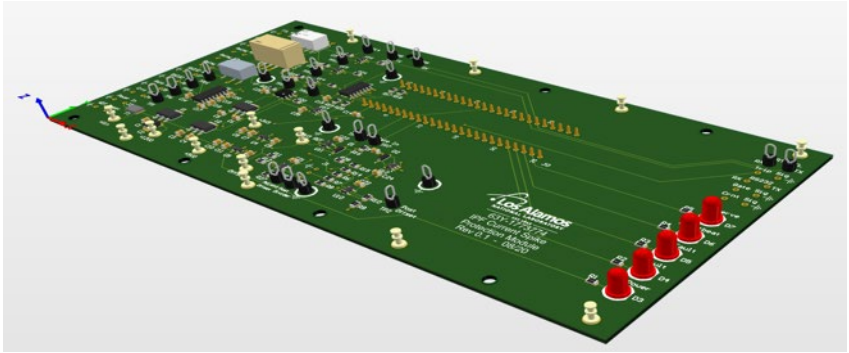
Old Circuit Board



New Circuit Board

- New chassis uses FPGA and ECL counters to achieve 1ns hardware resolution
- RF portion of PCB validated, FPGA development currently underway

IPF Current Spike and Charge Protection Module

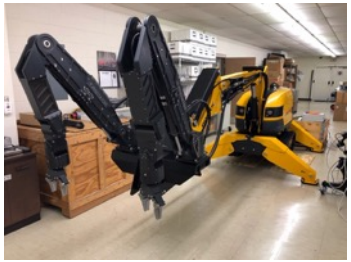


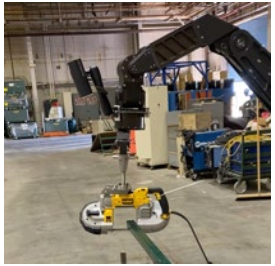
- Originally implemented in 2021 to eliminate high current spikes to IPF but recently modified to add charge-based protection.
  - Provides faster input into Fast Protect system than the HWTM current monitoring system.
- Pulse by pulse protection by monitoring the amplitude of every beam pulse.
- Calculates and updates charge delivered every microsecond.

Target Team

First Use of the "Predator"

C0-60 source transfer and IPF window dismantlement





Target 4 Upgrades

First use of an additive manufactured rifled target housing

Addition of beam position thermocouples

TMRS MKIV Assembly

TMRS assembly, welding, testing, preparing for install

Upper Target

TMRS Assembly

New moderator and target water system upgrade design and testing

Beam Operations Team

Startup

- Executed **144 interlock checks** on safety systems to get initial beam authorizations and ensure we remained compliant with DOE approved LANSCE Accelerator Safety Envelope throughout the run cycle.
- Executed **53 System Run Permit Checks** and **24 Fast Protect Checks** to get initial beam authorization to all areas.
- Revised, reviewed, and approved ~100 Accelerator Operations Manual sections (30 requiring USIDs/screens)
- In collaboration physics team got beam tuned to all experimental areas

Operations

- Operated, monitored, and responded to faults on 1000s of pieces of equipment to deliver beam to the 5 user facilities.
- Corresponded with and collaborated with many teams and organizations to ensure the best possibly beam quality and reliability.
- Despite challenging circumstances, CCR maintained minimum staffing requirements throughout run cycle – many operators had to work extra shifts but the control room stayed open for business
- Initial response to and recovery of beams following 5 major power outages.

Much Improved Work Spaces

The group made work spaces shine! Our spaces look like care.

- Official 5S of MPF-22.
- Major cleanup in Protective Systems Shop and cable yard.
- Target Team moves to MPF-4.
- Upgrade to CCR lobby!
- Magnet pad and Area A East parking lot cleanup progress.
- Another 100 or so tons of scrap metal re-located, surveyed, and released for recycle.

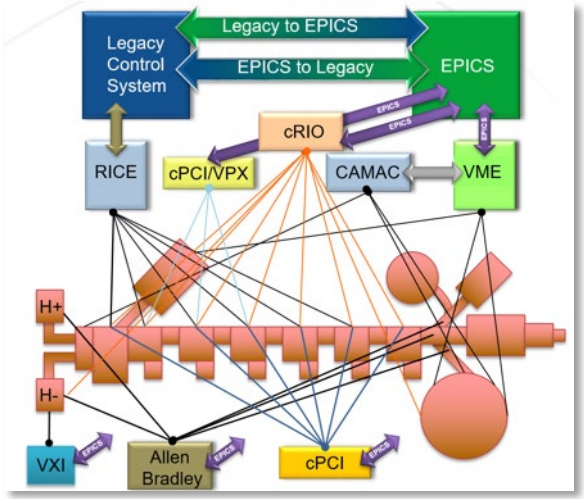
One corner of MPF-22 Before

One corner of MPF-22 After

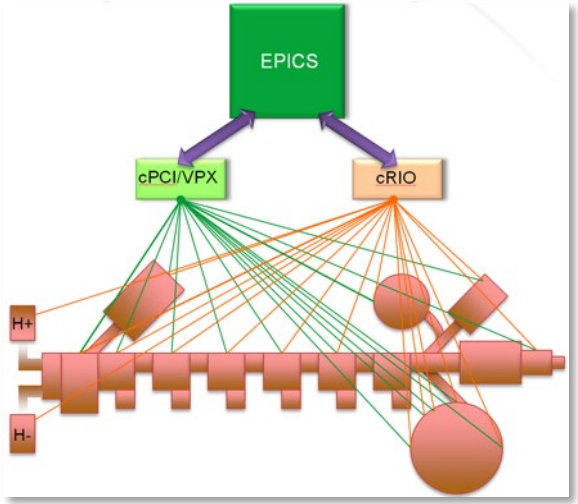
Group Highlights

Instrumentation and Controls

LANSCE Instrumentation and Controls Infrastructure



LANSCE Control System 1970-2020



LANSCE Control System Future Concept

Goal: Removal of RICE & CAMAC Systems

- Replacing past end-of-life / obsolete equipment
- Upgrading equipment that is causing operational inefficiencies
- Enabling previous unattained capabilities through modern equipment

Benefits: Supporting ONLY two platforms

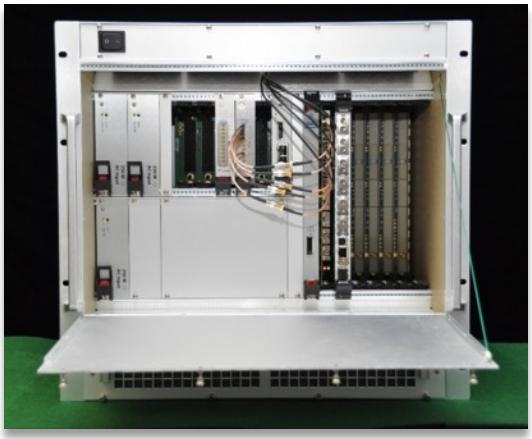
- More cost effective & maintainable infrastructure
- Simplified and modern architecture improving system reliability
- Real-time measurements enabling shorter tuning time, improved beam quality & beam availability

RECAP: Time and Flavored Data Migration - RICE to TDAQ

TAFI Card In Service at Module 6

Interface Conditioner (TAFI)

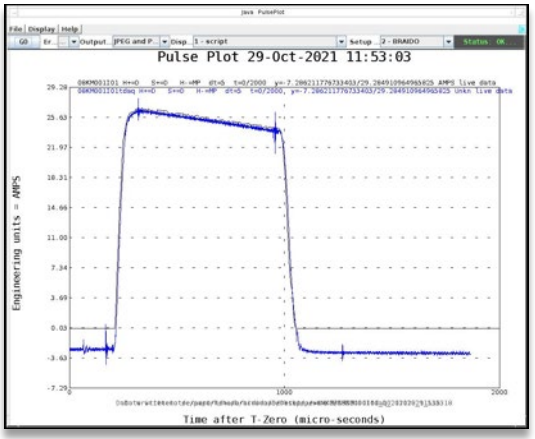
Development of an analog conditioning board that provides high impedance to customer interfaces and 50ohm drive to high speed ADCs.



VPX Chassis

VPX Data Acquisition (TDAQ)

Deployment of VPX chassis at every T&F RICE module for upgrade during the 2022 outage. The “Final Piece” to retire the RICE system.



Pulse Plot Results for RICE and TDAQ

Comparison of RICE to TDAQ

Black = RICE data service
Blue = TDAQ data service

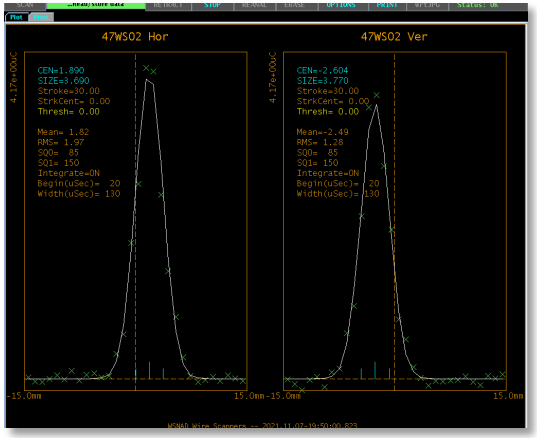
Time Improvements
RICE returns 1 waveform in ~30secs
TDAQ returns 1 waveform in 0.25secs

RECAP: Wire Scanner Upgrades

Quad Actuator Controller (QAC)

New Electronics for Actuators

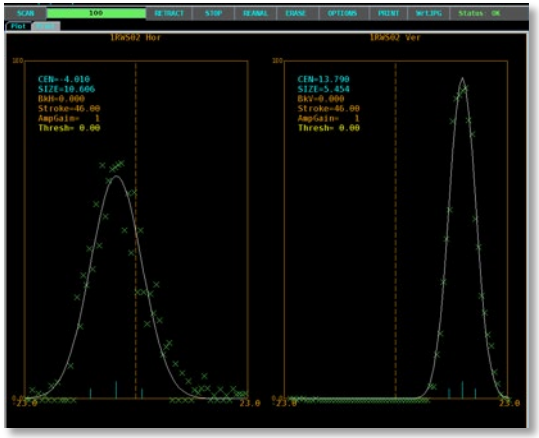
Operation of up to 4 actuator devices and supports legacy designs as well as new actuator devices in the LINAC.



47WS02 beam profile taken during beam development

LINAC Upgrades to wire scanners

New Locations: 40WS1, 43WS1, 46WS1, 47WS1, 47WS2, and 48WS1

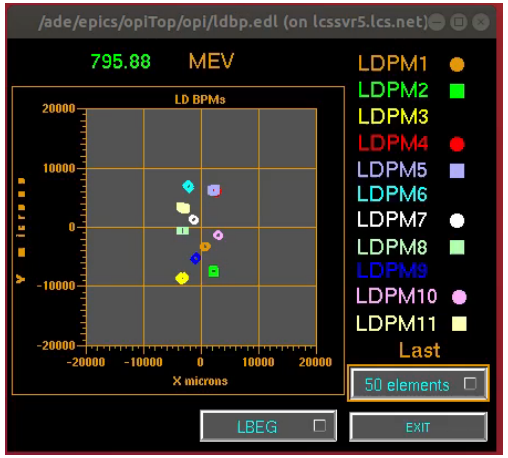


1RWS02 beam profile using the new WSQD software

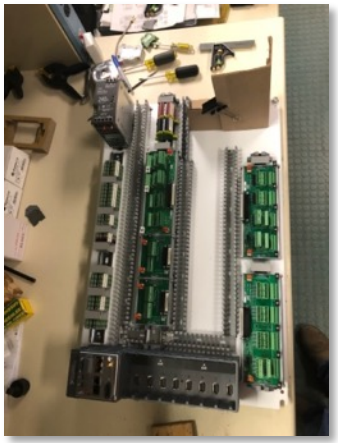
Upgrades to MEB CAMAC wire scanners

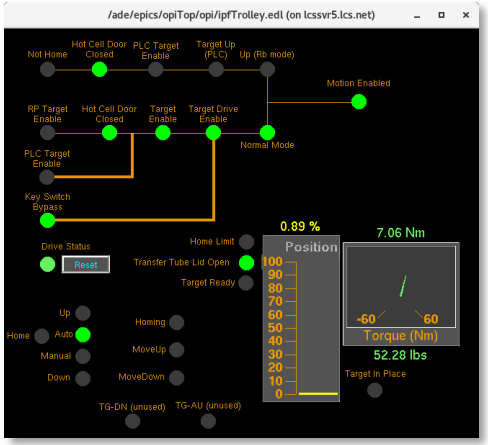
Development set of hardware (QAC/DAQ) which eliminates the dependency on obsolete legacy digitizers. Successful testing provides upgrades paths for 52 wire scanners in the SY and beyond

Line D BPPMs and IPF Trolley



Movie of Line D North Beam Position Overlay





Trolley Electronics Screen, Assembly and Installation

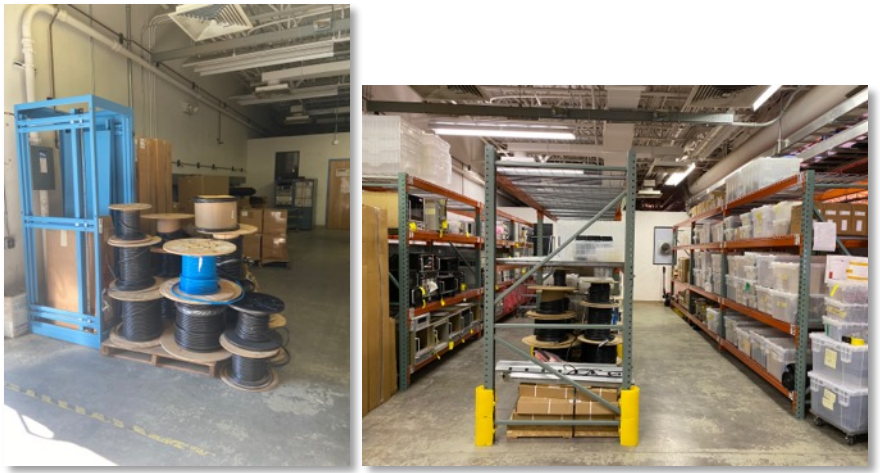
Line D North BPPM Upgrade

This project was able to use the existing cabling and beam position monitors in the beam tunnel and upgrade the electronics package for processing horizontal, vertical, phase and intensity waveforms.

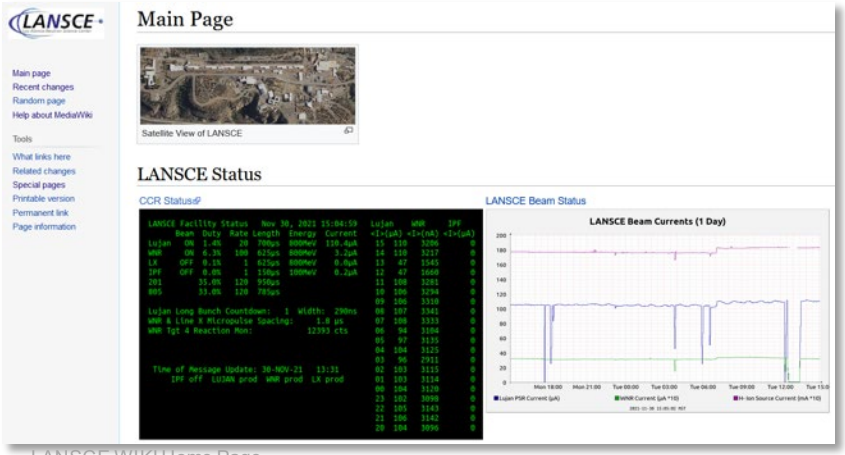
IPF Trolley Electronics Assembly

AOT-IC changed the IPF Trolley from a PLC based control system to a cRIO based control system. The new system provides the same capability as before with additional interfaces to monitor interlocks, motion commands and position read backs at the hot cell and in the IPF control room.

MPF-18 5S and LANSCE WIKI



Before and After of MPF-18 Cage



LANSCE WIKI Home Page

MPF-18 5S Project

AOT-IC space allocation was reduced in MPF-365. The MPF-18 cage space was upgraded with shelving and bin storage to accommodate spare inventory. All spare parts locations have been categorized and recorded for inventory management.

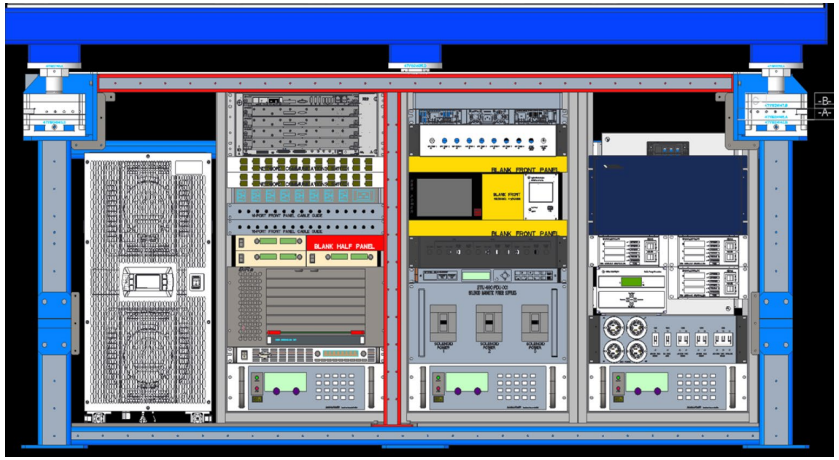
LANSCE WIKI available to AOT

http://wiki.lcs.lanl.gov

A resource available to AOT groups to post operational information, schedules and project documentation for LANSCE.

Scorpius Control System Development

- Control and monitoring of subsystem hardware:
  - Leverages NI cRIO embedded controllers
    - Power Distribution
    - Vacuum Subsystem
    - Magnet Power Supplies
    - Core Reset Sub Subsystem
    - Magnet Water Cooling Subsystem
- Electronics Testing
  - EMI Survivability
  - Radiation Survivability



Scorpius Accelerator Module Electronics

Group Highlights

Radio Frequency Engineering

805 HPRF Systems

- Sector F IVR failed the end of June, 2021
  - The IVR was unable to increase the sector voltage beyond a certain level.
  - The only viable replacement IVR was installed in sector A, module 4.
  - To make that IVR available, the IVR from the ETL was removed, and installed in sector A, module 4.
  - The failed sector F IVR was then removed and replaced with the IVR from sector A.
  - Sector F was recovered and operations were able to continue.
  - This left the 805 HPRF systems without the ability to test klystron/modulators at the ETL.
  - After going through all available spares, 805 was left to assemble untested klystron/modulators from “good parts” of failed klystron/modulators.
  - We ended the run period with one spare.

Vacuum Breaker Cabinet

Inductive Voltage Regulator (IVR)

201 HPRF Systems

- Installation of Tetrode based amplifier (SSPA + Tube Amplifier+ circulator) in M1
- Optimization of M1 for LLRF and Beam delivery
- RFQ test stand incorporated in 365 Test Stand capabilities
- Window Test Stand construction finalized and installed in 365.
- Cleanup efforts underway for legacy equipment in Sector A and 365.

LLRF Systems

- Received Recapitalization funding from NA-50 for completing installation of dLLRF at LANSCE
  - dLLRF for sectors F-H, PSR and LEBT
  - Refurbish RF Phase Reference transmission line slip-joints, couplers and insulation
  - Finish updating RF Phase Reference transmission line temperature controllers
  - Ordering of long-lead material complete
  - Fabrication started

Installed new Drive Line Temperature Controllers in Sectors A-C, RF Phase Source Room

DC & PP Systems

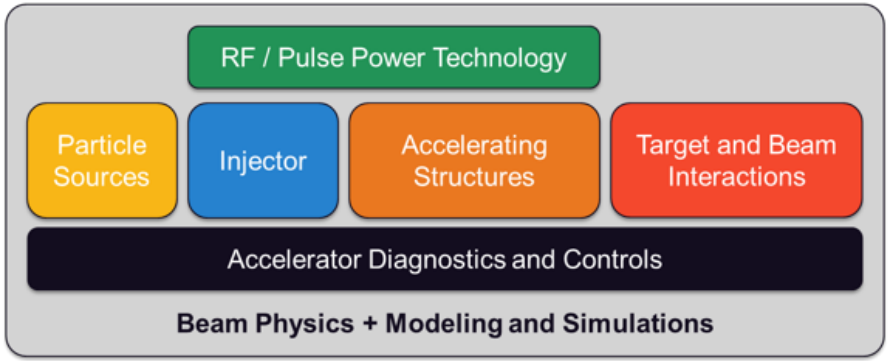
- Upgraded 19 steering magnet supplies in the PSR, eliminating the last of the problematic and inefficient Class-A Kepco supplies at LANSCE.
- Upgraded magnet power supplies for RIQU003, RIQF005, RIQF006, LDQS001, SROM021, and SROM022 in the PSR.
- Cleaned all HV components and replaced Blumleins and insulating oil in the SRFK high voltage enclosures.
- Performed heroic efforts to maintain operation of SRFK kicker modulators after it was discovered that our supply of spare Blumlien cable had been degraded.
- Simultaneously supported LANSCE, PHELIX, and SCORPIUS modeling, testing, and operations.

Group Highlights

Applied Electrodynamics

(Formerly Accelerators and Electrodynamics)

AOT-AE has significant involvement and leadership across all ASET categories in NPF

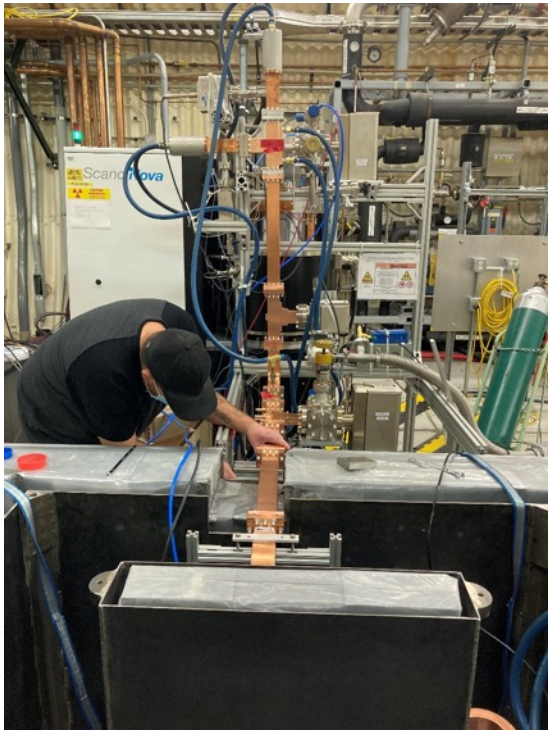


- Large investment in Accelerating Structures, with a focus on High-gradient NCRF development (cyro-cooled C-band); highly synergistic with HEP needs
  - LANL has invested in high-power C-band test station (FY19) –will be used to test GARD-developed components from SLAC
  - LDRD DR on high-gradient NCRF development at C-band PI: Evgenya Simakov (FY19-22)
  - Joint UCLA-LANL UC Fees proposal on high-gradient NCRF (FY20-22)
  - DMMSC can leverage GARD-funded high-gradient NCRF research and, in turn, can become GARD's multi-stage NCRF prototype
  - Aligned with the new **Strategic Accelerator Technology** initiative, **Advanced Technology R&D** and **Accelerator Stewardship** sub-programs
- Large investment in Accelerator Diagnostics and Controls
  - **New LDRD DR "*Adaptive Machine Learning for Closely Spaced Ultra-Short Intense Accelerator Beams*" (FY22-24)**
    - Will aid in the diagnostics and control of high-intensity, ultrashort beams by interfacing online models with real time non-invasive beam data, providing a detailed virtual view of intense bunch dynamics (beyond the reach of existing diagnostics)
  - Directly aligned with the DOE HEP **Artificial Intelligence and Machine Learning initiative**

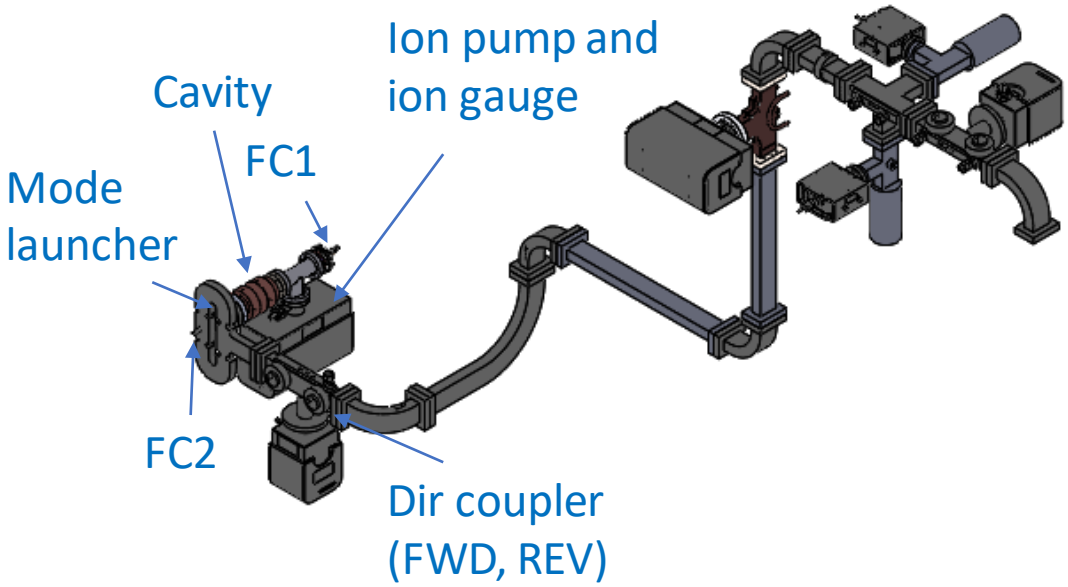
LANL C-band Engineering Test Facility (CERF-NM)

UC XFEL collaboration will leverage about $3M of LANL's internal infrastructure investment.

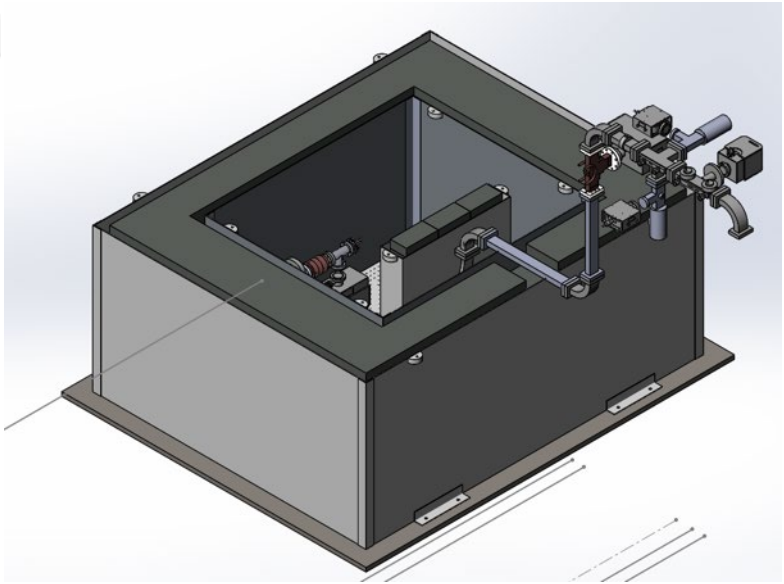
- Powered with a C-band Canon klystron
- Conditioned to 50 MW
- Frequency 5.712 GHz
- 300 ns – 1 μs pulse length
- Rep rate up to 200 Hz (typical 100 Hz)
- Nominal bandwidth 5.707-5.717 GHz



Schematic of the C-band test stand

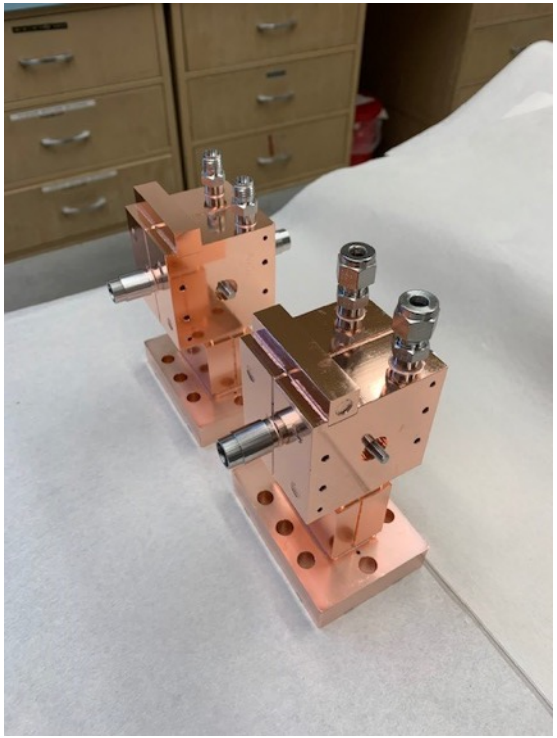


Radiologically certified for dark currents up to 5 MeV and 10 µA.



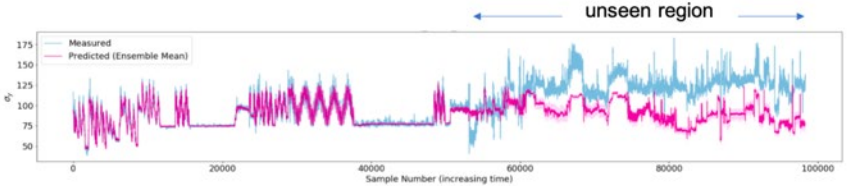
First high gradient cavities tested at CERF-NM

- LANL's high gradient C-band test facility is the only high gradient C-band test facility in the US and is open to collaborators.
- LANL provided us with Technology Evaluation and Development (TED) funding to test SLAC's C-band beta=0.5 cavities at high gradient.
- SLAC delivered two cavities to LANL: one made of copper and another one made of copper-silver alloy.

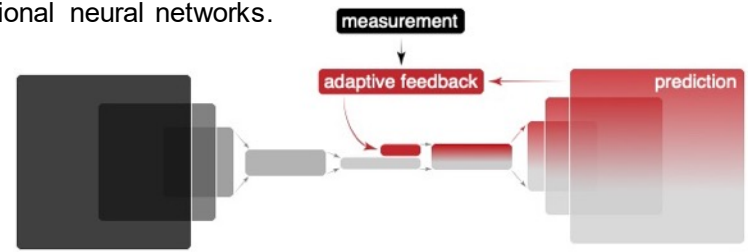


Project Update: Adaptive Machine Learning for Advanced Diagnostics and Autonomous Control of Compact Particle Accelerators (Alex Scheinker)

Background: Particle accelerators and their beams are time-varying. Traditional machine learning methods cannot handle time-varying systems. *New adaptive machine learning methods are needed for advanced accelerator controls and diagnostics.*

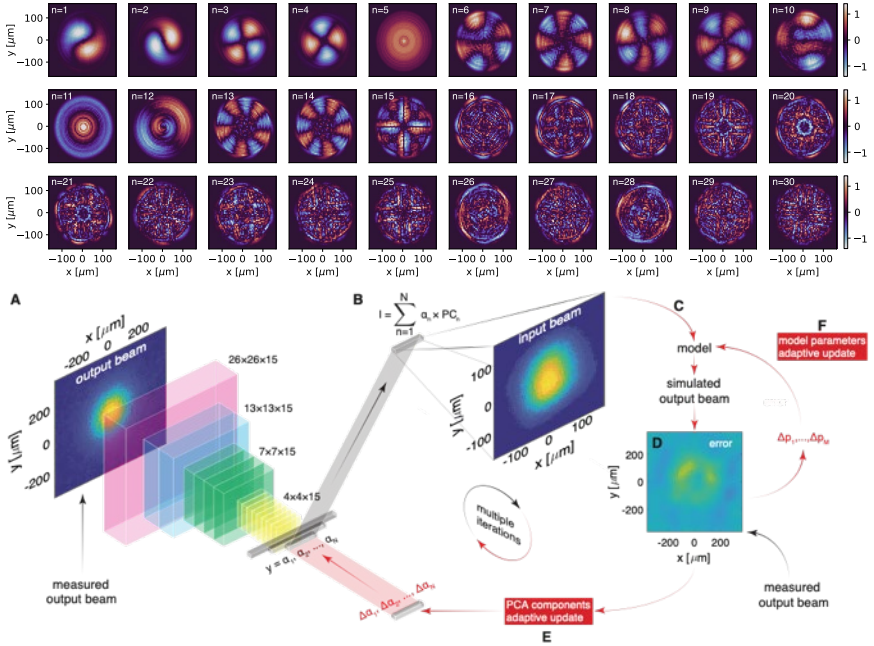


Adaptive Machine Learning: LANL is developing adaptive machine learning-based tools for non-invasive diagnostics and autonomous control of particle accelerators by combining model-independent adaptive feedback with ML tools such as convolutional neural networks.



A. Scheinker. "Adaptive Machine Learning for Robust Diagnostics and Control of Time-Varying Particle Accelerator Components and Beams." *Information* 12.4 (2021): 161.

HiRES: Adaptive convolutional neural network maps output beam measurements to the principal components that represent the input beam distribution which was used to generate them.



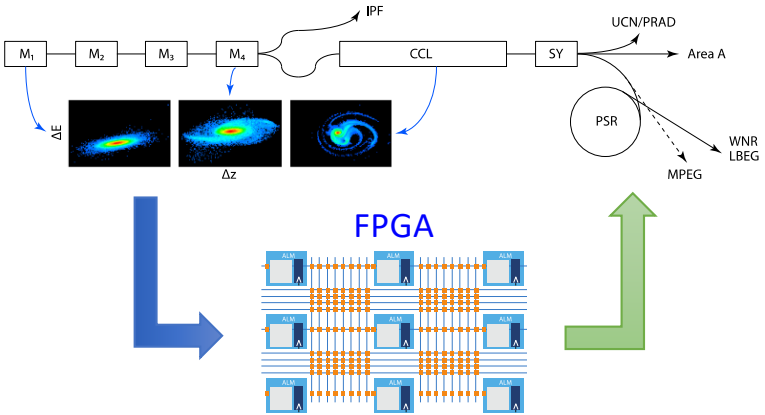
Scheinker, A., Cropp, F., Paiagua, S., & Filippetto, D. (2021). Adaptive deep learning for time-varying systems with hidden parameters: Predicting changing input beam distributions of compact particle accelerators. *arXiv preprint arXiv:2102.10510*.

Project Update: Adaptive Machine Learning for Advanced Diagnostics and Autonomous Control of Particle Accelerators (Alex Scheinker)

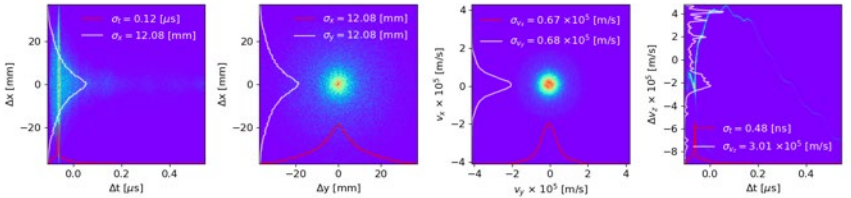
Future work: Machine learning for time-varying systems is a problem of importance not only to the particle accelerator community, but to the machine learning community in general. There is a lot of potential to generalize these new tools and to develop controls and diagnostics for a wide range of accelerator applications. Next steps include:

1). Adding a dedicated postdoc to the AML effort.

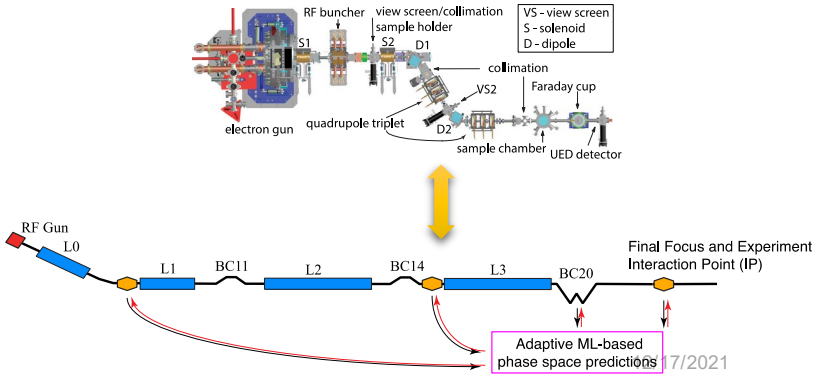
2). Real-time AML implementation on the edge, using real-time processing such as field programmable gate arrays (FPGA).



3). More extensive simulation studies of complex beam dynamics, expanding the range of applications of AML.

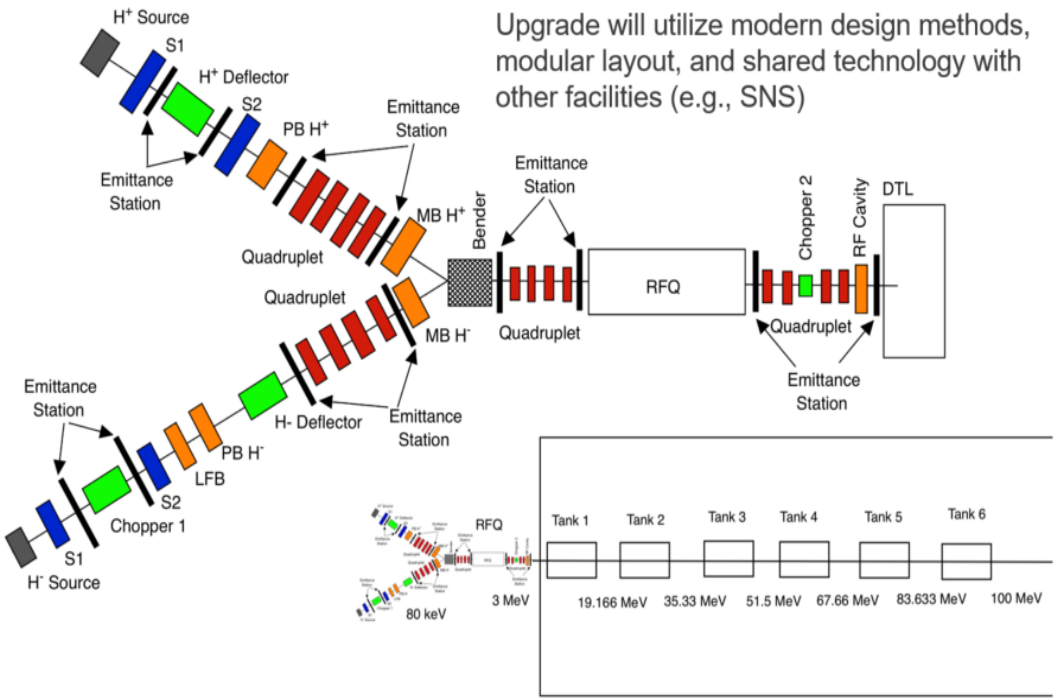


4). We have demonstrated that a 5 meter long compact and flexible accelerator such as HiRES could be used to develop tools that are applicable to a large machine such as the 1 km FACET-II. Continued work can focus on continued development of flexible AML tools that can benefit various facilities.



AE plays a lead role in the LAMP project to modernize obsolete equipment and methods at the front end of the accelerator

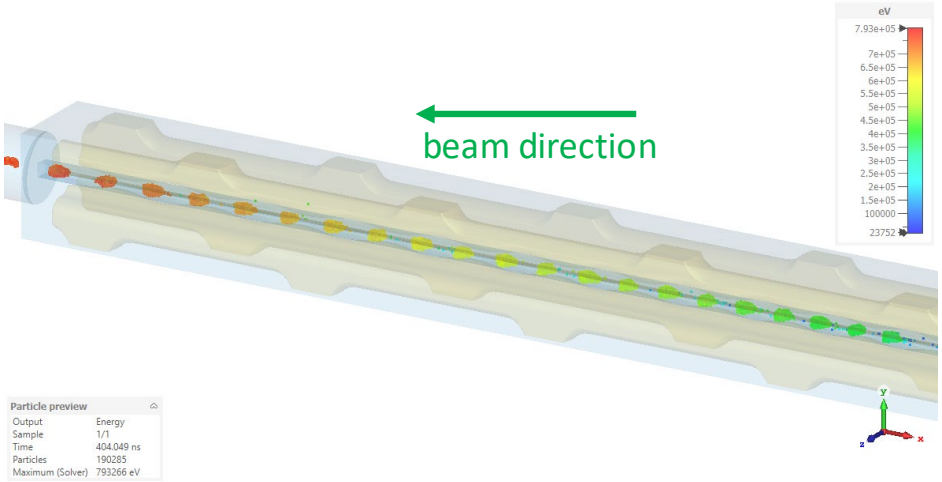
- Upgrade of sources to end of Drift Tube Linac (DTL) at 100 MeV
  - ❑ Utilizes latest advances in accelerator design (e.g., not just like-for-like replacement of components)
- System integration and testing to 20 MeV (sources to end of first DTL)
- System integration and testing up to 100 MeV (sources to end of last DTL)
- Development of controls and new operating procedures
- Operator training on new systems before deployment in LANSCE tunnel



Conceptual Design Authors: Dmitry Gorelov, Yuri Batygin, Larry Rybarcyk, Sergey Kurennoy, Ilija Draganic, Dimitre Dimitrov

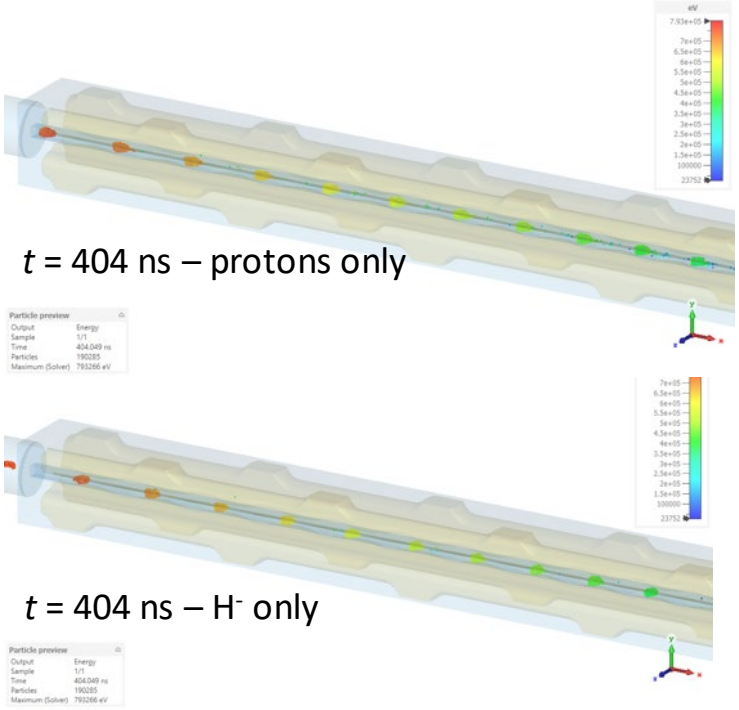
Thanks to FY21 investment and LUFD support, preconceptual efforts in Mod/Sim show LANL RFQ with simultaneous p & H^- beams

Two beams near RFQ exit: all particles (left), p or H^- only (right)



t = 404 ns; 190,285 particles total

Snapshot at t = 404 ns; color shows energy



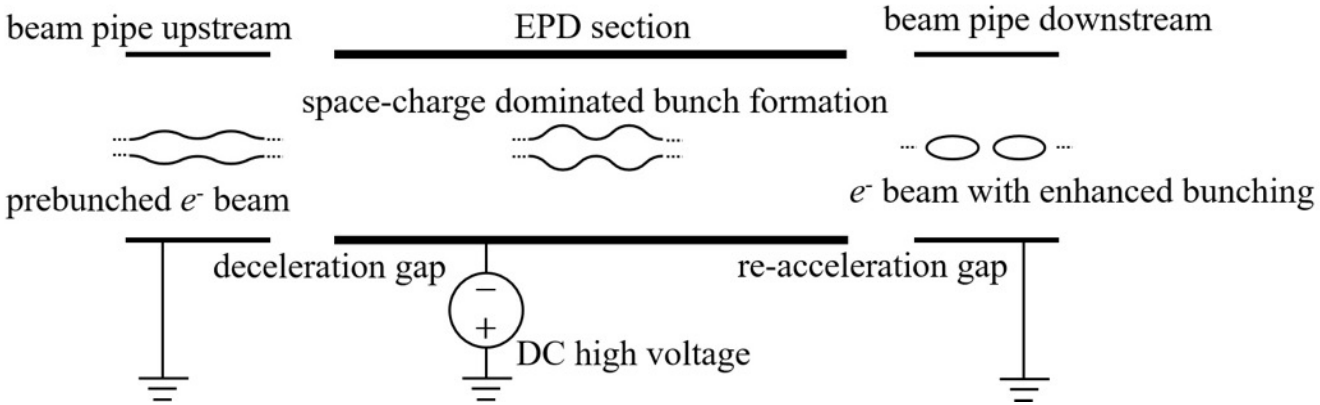
t = 404 ns – protons only

t = 404 ns – H^- only

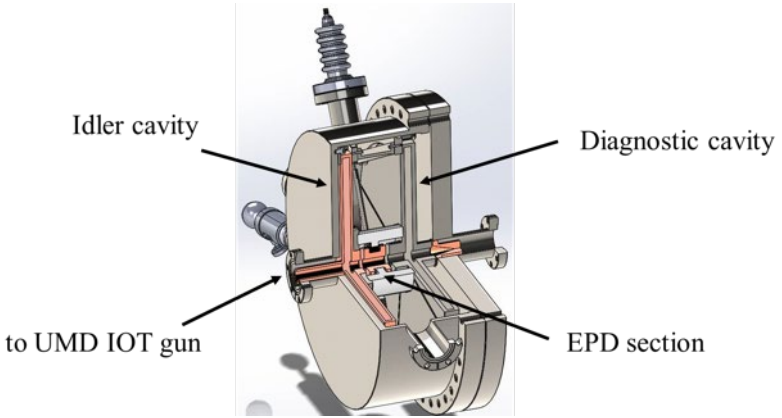
The use of the same RFQ for accelerating multiple beams (with different species and different current densities), though is novel approach, but looks practical, and allows us both, increase the availability of the whole system (due to simplification, and reduction of number of =the required components), and simplify maintenance, required for supporting of those system.

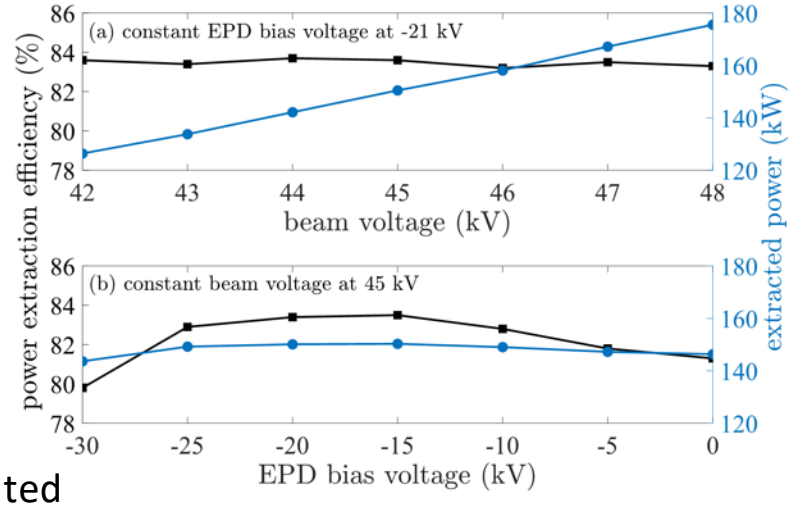
Project update: High-Efficiency Klystron with Post Acceleration

- PI – Quinn Marksteiner (AOT-AE)
- DOE HEP Stewardship project, FY19-FY21 with University of Maryland
- Goal: Investigate a novel scheme to increase klystron efficiency to nominally 80%
  - A section of the beam drift tube is floated at a voltage near, but less negative than, the cathode voltage. If the voltage depression is large enough, the beam becomes close to the space-charge limit and nonlinear bunching can occur.
  - This bunching is "frozen in" as the beam is post-accelerated at the end of the depressed section, and with a relatively low energy spread. High-efficiency power extraction can then take place in the output cavity.



High-Efficiency Klystron with Post Acceleration: numerical demonstration and optimization completed



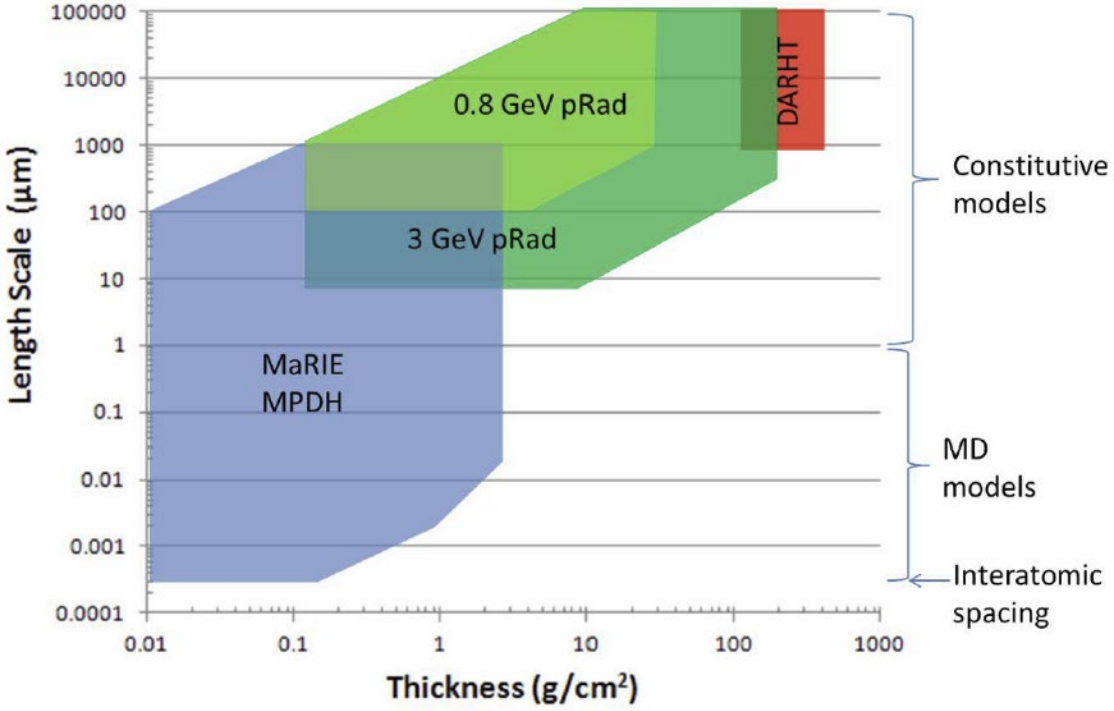


- Optimizing cavity parameters with EPD implemented enhances power extraction efficiency to target value [1].
- Next steps:
  - July: Receive solenoids and cavity assembly in early July, do cold testing.
  - August: Ship parts to UMD, set up experiment and activate gun, clean parts and perform a cold test at UMD.
  - September – October: High power testing, measure enhancement of bunching from EPD section.
  - November – December: Publish results and write final report for project.

[1] IEEE Trans. on Electron Devices, **68**, 4 (2021)

LANSCE Futures: Exploring Radiographic Capabilities of 3-GeV Proton Radiography

- Increasing the proton energy from 800 MeV to 3 GeV improves the radiography resolution by a factor of 10.
- Bridges the gap between DARHT and future DMMSC, which can provide the finest resolution.
- Allows for thicker objects and finer resolution than current pRad.



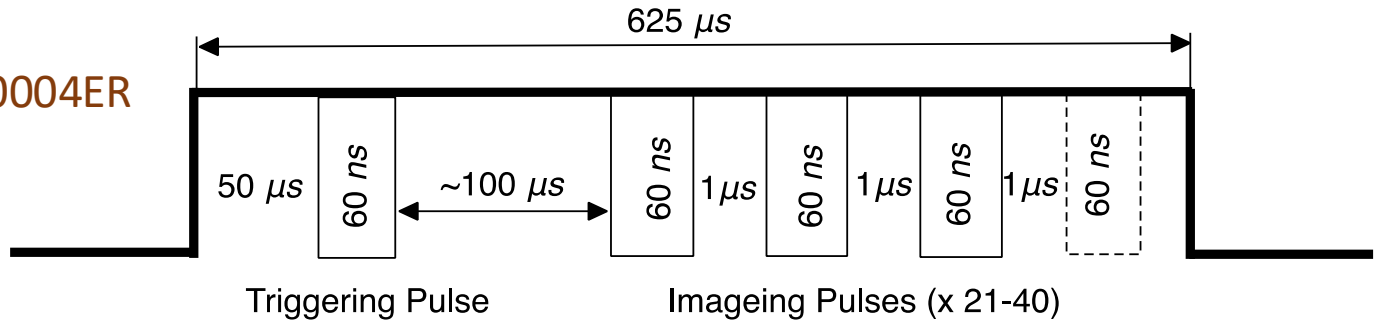
LDRD 20210004ER

Parameters for Existing and Upgraded pRad

	Existing	Upgraded
Energy (GeV)	0.8	3
FWHM momentum spread, dp/p	1×10^{-3}	3.3×10^{-4}
Beam current / bunch (mA)	10	19
Protons per pulse	5×10^{9}	9.5×10^{9}

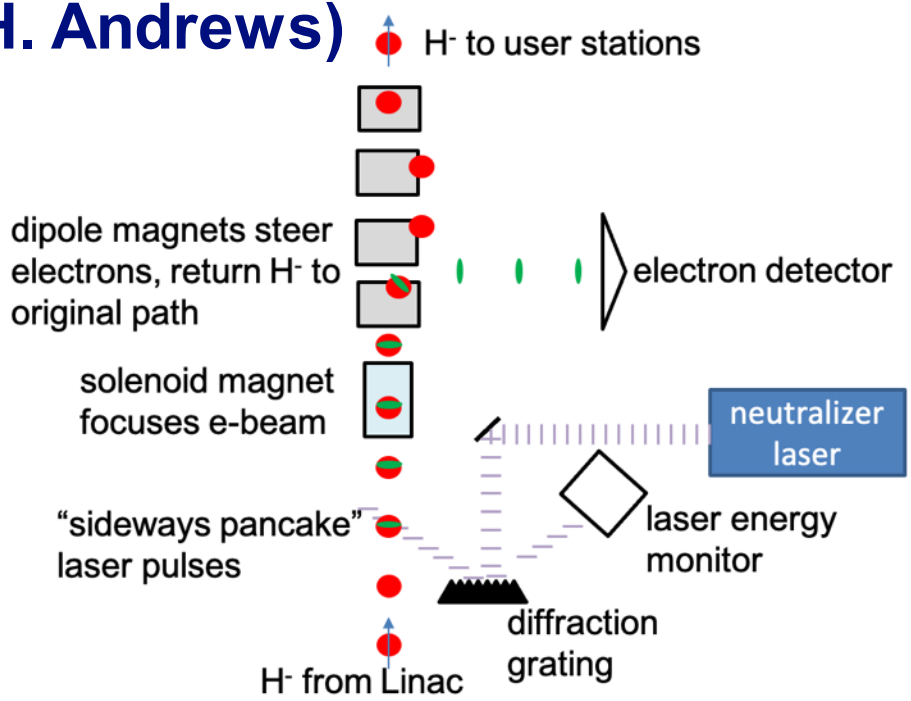
LDRD 20210004ER

Time structure of LANSCE pRad beam



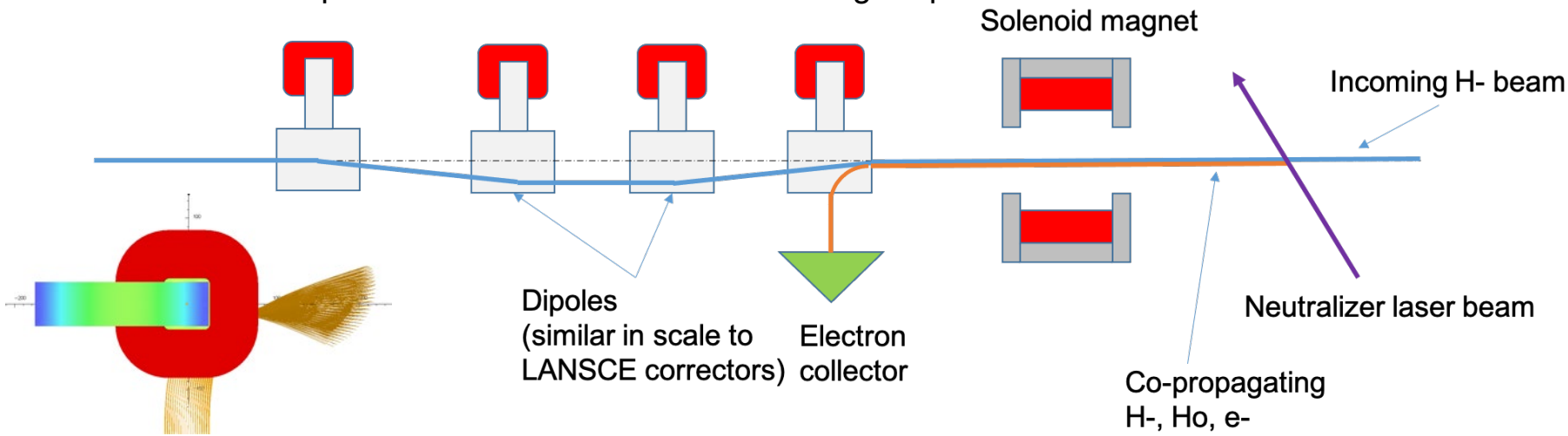
Neutralizer-Based Longitudinal Bunch Profile Measurement 20210156ER (H. Andrews)

- We are developing a non-perturbative longitudinal diagnostic for MeV- to GeV-range H- ion beams, via the use of a picosecond neutralizer laser to selectively strip a portion of the beam from H^- to H^o
- This will measure and report an actual beam distribution, rather than an RMS or other quantity
- *Due to available locations, we will detect the electrons rather than H^o* – This does not impact our expected results



Methodology and proposed hardware

- Use a tilted phase-front laser to keep the laser "short" while velocity matching the H- beam
- Varying the timing between the laser beam and H- beam, we can "map out" the H- beam longitudinal profile
- Use a solenoid and small dipole to focus and deflect the stripped electrons into a collector
- Use additional dipoles to restore the H- beam to its original path



AOT Goals for FY22

Key Focus Areas

- Moving from expert-based to process-based.
- Choices and decisions should be geared towards improvements in accelerator and target reliability, maintainability, operations, and training.
- The division also seeks to improve its capabilities in accelerator technology and operations through a diverse set of R&D (vision-aligned LDRD) and projects such as LAMP and Scorpius.
- Progress and updates should be tracked by management (group/division) over the course of the year.

Primary Areas of Focus

- Operations
- Maintenance and Upgrades
- Asset Management, Risk Mitigations, and Maintenance Analytics
- Research and Development
- Projects
- Division, Group, and Team Management
- Personnel Development
- Safety, Security, and the Environment

Opening up one

- Operations
  - Availability
    - Improve on past performance (>85% when subtracting events outside of our control)
    - Set system specific goals to achieve this number
  - Reliability
    - Deliver beam as planned and promised
      - Tied to maintenance planning – We must be ready!

Next Steps

- Groups have the more complete list of focus areas provided by the DO
  - They have been asked to set group and team goals based on the higher level divisional goals
- Refine the divisional goals to meet those that the groups have agreed to and believe are achievable
- Set personal goals for group members based on the group goals
- Frequently revisit progress on the goals throughout the year

Questions?

Reminder

$$\text{Question response time} \propto \frac{1}{(\#\text{ of people in room})(\text{question complexity})(\text{IQ of responder})(\text{responder knowledge})}$$

You have some control

Thank you for the great year!

Enjoy the time off.

Stay safe. Stay well.